[Name of Document] SPECIFICATION

[Title of the Invention] INNER ROTOR MOTOR AND DISK DEVICE

[Claims]

[Claim 1] An inner rotor motor comprising:

a rotor having a plurality of circumferentially arranged magnetic poles;

a stator having a stator core located outside the circumference of the rotor and having a plurality of magnetic pole teeth opposing the rotor, coils being provided in the respective magnet pole teeth of the stator core,

wherein the stator is arranged within a range of 180° about a central angle of the rotor, and

wherein a pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor is established smaller than a pitch of between the magnet poles in the circumferential direction of the rotor.

[Claim 2] A motor according to Claim 1, wherein the pitch of between the magnet poles in the circumferential direction of the rotor is established 1.5 times of the pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor.

[Claim 3] A motor according to Claim 1, wherein the stator is arranged within a range of 90° about the central angle of the rotor.

[Claim 4] A motor according to Claim 1, wherein the six magnetic pole teeth are provided.

[Claim 5] A disk device comprising an inner rotor motor

according to any one of Claims 1 to 4.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a technique which can be preferably used for a thin inner rotor motor for rotatably driving a medium which is used for in a floppy disk driving device or the like, for example.

[0002]

[Description of the Related Art]

A disk such as a floppy disk device has been popularly used in an office computer, a word processor, and the like in addition to a personal computer, and the application of the disk device has been spreading. This type of disk device is constituted as shown in Fig. 10, for example.

[0003]

In the description of the general construction of the disk device with reference to the drawing, numeral 101 in the drawing denotes a chassis having a spindle center 102 as the center of rotation of a disk. The chassis 101 is housed inside an equipment casing (not shown) of a personal computer or the like, for example, and is formed like a bottomed box having a casing space, which is entirely front-opened and opened upward and is facing a disk cartridge 103.

The chassis 101 is provided with a stepping motor 124 disposed at a rear end for feeding a head carriage and the head carriage arranged movably in the back and forth directions by the stepping motor 124. The head carriage is

provided with a first head 130 held at an end for reading recorded information on a disk and a head arm 132 swingably disposed with an elastic body therebetween and having a second head 131 which corresponds to the first head 130. The head arm 132 is urged in the direction that the second head 131 approaches the first head 130. This type of disk device comprises a cartridge holder 136 for holding the disk cartridge 103 such that the disk cartridge 103 can be inserted and removed, and a mechanism for opening and closing a shutter of the disk cartridge 103.

[0004]

By the way, in order to cope with the recent requirement for reducing the thickness of the disk device, a disk device of the type having an inner motor shown in Figs. 11(a) and 11(b) as a motor for rotating a disk has been adopted.

This inner motor comprises a stator 164 including an annular yoke 161 extending in the circumferential direction and a large number of cores 163, which are radially arranged on an inner peripheral surface of the yoke 161 and around which coils 162 are wound, and a rotor 166 rotatably arranged in an inner periphery of the stator 164 and having an annular magnet 165 facing the cores 163. In the drawing, numeral 168 denotes a circuit board, on which a holding portion 170 incorporating a bearing 169 therein is mounted; numeral 171 denotes a rotary shaft for fixing a rotor, which is rotatably journaled on the holding portion 170 on the circuit board 168 with the bearing 169 therebetween and has an axis extending in the vertical direction. In addition, the rotor 166 of the

inner rotor motor functions as a turntable having a magnet for chucking a disk (not shown) and a rotary lever for chucking a disk (not shown).

[0005]

In the stator for the inner rotor motor of the type, the yoke 161 and the cores 163 are arranged so as to surround substantially the entire periphery of the circular rotor 166 except for a position where the heads 130 and 131 move. In order to satisfy the required magnetic characteristics of these elements, the yoke 161 and the cores 163 are made of silicon steel which is larger in cost in comparison with a galvanized steel plate constituting the chassis 101 and the like.

[0006]

[Problems to be Solved by the Invention]

However, in the desk device of the type, there has been a continuing demand for the reduction in the manufacturing cost while the demand of the reduction in size and weight of the device has been still strong.

Accordingly, the inventor of the present invention considers that there has been a demand for the reduction in areas of the yoke 161 and the cores 163 made of the expensive silicon steel in the stator of the inner rotor motor.

[0007]

However, when the areas of the yoke 161 and the cores 163 are reduced to meet the above-mentioned requirement, the magnetic interaction with respect to the rotor 166 becomes non-uniform in the circumferential direction so that there

exists a possibility that the operational stability of the disk cannot be ensured.

Further, in the inner rotor motor that is driven with three phases, for example, it is demanded to establish a state in which the coils corresponding to the respective phases uniformly act on the rotor.

[0008]

The present invention has been made in view of the above-mentioned circumstances and has been provided so as to achieve following objects:

(1) Reduction in manufacturing cost

(2) Advances in reduction in size and weight of the device

(3) Maintaining stability of motor rotation

(4) Enhancement of operational stability of the disk device

[0009]

[Means for Solving the Problems]

An inner rotor motor according to the present invention comprises a rotor having a plurality of circumferentially arranged magnetic poles; a stator having a stator core located outside the circumference of the rotor and having a plurality of magnetic pole teeth opposing the rotor, coils being provided in the respective magnet pole teeth of the stator core, wherein the stator is arranged within a range of 180° about a central angle of the rotor, and wherein a pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor is established smaller than a pitch of between the magnet poles in the circumferential direction of the rotor, so that the above-

mentioned problems have been solved.

According to the present invention, preferably, the pitch of between the magnet poles in the circumferential direction of the rotor is established 1.5 times of the pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor.

More preferably, the stator according to the present invention is arranged within a range of 90° about the central angle of the rotor.

Also, according to the present invention, preferably, the six magnetic pole teeth are provided.

A disk device according to the present invention comprises the above-described inner rotor motor.

[0010]

According to the present invention, the stator is arranged within a range of 180° about the central angle of the rotor, so that the stator core area can be reduced by about half or less in comparison with the case where the stator is located around the entire circumference, thereby reducing the manufacturing cost of the inner rotor motor by decreasing the cost for the stator core made of a silicon steel plate and for the coil winding. Simultaneously, miniaturizing of the device is enabled in comparison with the case where the stator is located around the entire circumference by reducing the area required for attaching the motor while the reduction in weight can be made because the number of magnet pole teeth can be reduced. In this state, the pitch of between rotor-facing surfaces of the magnetic pole teeth in the

circumferential direction of the rotor is established smaller than a pitch of between the magnet poles in the circumferential direction of the rotor, so that in comparison with the case where the pitch of the magnetic pole teeth is the same as or larger than the pitch of the rotor magnetic poles, the area of the magnetic pole teeth is reduced while the area of portions, to which the magnetic pole teeth are connected, i.e., the area of the yoke is reduced, thereby miniaturizing the stator in particular and enabling the manufacturing cost to be reduced by miniaturizing the coil winding. In other words, the angular density of the magnetic pole teeth about the central angle of the rotor rotational center is set larger than the angular density of the rotor magnetic poles, so that the entire size of the stator can be reduced by maintaining the number of the magnetic pole teeth of stator constant.

In addition, other than the state that the stator is continuously arranged within a range of 180°, the total sum of the central angles, in which a plurality of stator portions having spaces are positioned, may be within a range of 180°. Also, the reduction in manufacturing cost, weight, and size can be further promoted by arranging the stator within a range of 90° about the rotor central angle.

[0011]

The coil according to the present invention includes the U-phase coil receiving a first driving current, the V-phase coil receiving a second driving current advanced than the first current in phase by 120°, and the W-phase coil

receiving a third driving current advanced than the second current in phase by 120° arranged in an order of the U-phase, W-phase, and V-phase, so that while the control state in the driving electric current can be maintained in the same manner as in a conventional three-phase motor, the coil width, i.e., the area of the magnetic pole teeth, can be dramatically reduced in comparison with a motor with coils arranged in an order of the U-phase, V-phase, and W-phase.

[0012]

According to the present invention, the pitch of between the magnet poles in the circumferential direction of the rotor is established 1.5 times of the pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor, so that the miniaturizing may be achieved by reducing the width of the coil by about 2/3 of that of a conventional motor while the manufacturing cost can be reduced by reducing the area of the magnetic pole teeth in the similar way.

[0013]

According to the present invention, the pitch of ends of the magnetic pole teeth in the circumferential direction of the rotor can be set at 15°.

[0014]

According to the present invention, providing the six magnetic pole teeth enables the inner rotor motor to be incorporated in a three-phase inner rotor motor.

[0015]

[Description of the Embodiments]

An embodiment of an inner rotor motor and a disk device according to the present invention will be described below with reference to the drawings.

Fig. 1 is a plan view showing part of the disk device according to the embodiment. In the drawing, numeral 1 denotes a chassis constituting part of a casing of the disk device.

[0016]

The disk device according to the embodiment is an example used as a floppy disk drive (FDD).

On the chassis 1 made of galvanized steel or the like, as shown in Fig. 1, a rotor 2 and a stator 3 of an inner rotor motor for rotating a magnetic recording medium (disk); a magnetic head 4 for reading and writing magnetic signals from and to the disk; a position controller 5 for positionally controlling the magnetic head 4; a substrate 6 for drive-controlling the position controller 5 and the inner rotor motor as a controller; a magnetic balancer 7; a magnetic shield 8; and a magnetic balancer 9 are arranged.

[0017]

Fig. 2(a) is a sectional view of the inner rotor motor at the line II-II of Fig. 1 viewed in arrow direction; and Fig. 2(b) is an enlarged sectional view showing the vicinity of a magnet 25 in Fig. 2(a).

As shown in Figs. 1 and 2, the rotor 2 comprises a disk 23 rotatably supported about a spindle center 21 fixed on a bottom surface of the chassis 1 as a rotary center and along a plane parallel with the bottom surface of the chassis 1

with ball a bearing 22, 22 therebetween; an engaging projection 24 protruded from the top surface of the disk 23 for transmitting a rotational drive force to the floppy disk by engaging with an engaging hole of the floppy disk; and the magnet 25 provided in a periphery of the disk 23 with some thickness and polarized so as to form a plurality of magnet poles arranged in a circumferential direction.

In the magnet 25, as shown in Fig. 1 and 5, N poles and S poles are alternately arranged in the circumferential direction, wherein the total number of these magnet poles is set to be 16, for example. That is, the magnetic poles 25n, 25s, ··· are alternately arranged 22.5° apart with respect to the center of rotation 21.

[0018]

Fig. 3 is a plan view of the stator 3 shown in Fig. 1

The stator 3, as shown in Figs. 1, 2, and 3, comprises a stator coil 31 comprising a yoke 32 and six magnetic pole teeth 33, 34, 35, 36, 37, and 38 connected to each other by the yoke 32; and coils 33a to 38a formed by winding around the respective magnetic pole teeth 33 to 38. The stator 3 is attached to the chassis 1 with the yoke 32 therebetween. The coils 33a to 38a are located at positions corresponding to a notch 11 of the chassis 1 formed from the rotary lower position to the side of the rotor 2.

[0019]

The notch 11 is formed from the position where the stator core 31 is attached to the chassis 1 to the rotary lower position of the magnet 25 of the rotor 2 so as to have

a shape allowing the coils 33a to 38a to be accommodated therein. Wherein the shape of the notch 11 is set to the extent in that the coils 33a to 38a can be accommodated therein in view of the strength of the chassis 1 and the positional relationship to notches 12, 13, and 14, which will be described later.

In addition, the contour of the notch 11 at the rotary lower position of the rotor 2 is set symmetrically with the contour of the notch 12, which will be described later, at the rotary lower position of the rotor 2 with respect to the rotational center 21. By setting shapes of the stator core 31 and the magnetic balancer 7, which will be described later, along with the above setting of the contours, the magnetic flux from the magnet 25 reaches the bottom surface of the chassis 1 so that it becomes possible to produce a downward thrust force acting on the rotor 2 in the linear direction passing through the stator 3 and the magnetic balancer 7.

[0020]

In the similar manner, in the notches 13 and 14, the contour thereof at the rotary lower position of the rotor 2 is set symmetrical with respect to the rotation center 21. By setting shapes of the magnetic shield 8 and the magnetic balancer 9, which will be described later, along with the above contour setting, the magnetic flux from the magnet 25 reaches the bottom surface of the chassis 1 so that it becomes possible to produce a downward thrust force acting on the rotor 2 in the linear direction passing through the magnetic shield 8 and the magnetic balancer 9.

[0021]

Next, the shape of the stator core 31 will be described.

[0022]

Fig. 4 is a plan view of the stator core 31 shown in Fig. 1.

The stator core 31 is made of a silicon steel plate. As shown in Figs. 1 to 4, each of the magnetic pole teeth 33 to 38 is provided with each of end portions 33b to 38b disposed so as to extend toward the rotor 2 further than coils 33a to 38a and each of winding portions 33c to 38c, around which the coils 33a to 38a are wound.

Each of the winding portions 33c to 38c has a width size uniform along the extending entire length. Each of the end portions 33b to 38b has a width size larger than that of each of the winding portions 33c to 38c, and is provided with each of rotor-facing surfaces 33d to 38d arranged at substantially equal intervals so as to face the magnet 25 of the rotor 2 and to have an arch shape in plan view.

[0023]

In the stator core 31, as shown in Fig. 2, the end portions 33b to 38b are arranged at positions lower than that of the magnet 25r of the rotor 2. That is, the central position of each of the end portions 33b to 38b in the height direction (direction along the rotational axis of the rotor 2) thereof is located at a position closer to the bottom surface of the chassis 1 than that of the magnet 25. Simultaneously, the coils 33a to 38a are located inside the notch 11 of the chassis 1.

The central positional displacement in the height direction between the end portions 33b to 38b and the magnet 25 is set such that a downward (toward the chassis 1) thrust load for maintaining the rotational stability of the rotor 2 is established in the same way as the setting of the height of the magnetic balancer 7, which will be described later.

[0024]

In the magnet pole teeth 33 to 38, as shown in Figs. 1, 3, 4, and 5, the rotor-facing surfaces 33d to 38d disposed at ends are established so as to have an arch shape with a radius of R1 having the same distance to a point aligned with the rotational center 21 of the rotor 2. The rotor-facing surfaces 33d to 38d are also arranged at equal intervals of a pitch P1 in the circumferential direction. That is, the pitch P1 of the rotor-facing surfaces 33d to 38d is a spacing between adjacent central positions 33g to 38g in the circumferential direction of the rotor-facing surfaces 33d to 38d indicated by an angle at the rotational center 21. The pitch P1 of the rotor-facing surfaces 33d to 38d is set to be 15°, for example.

Wherein, a value Q, which is a spacing between the central positions in the circumferential direction of the rotor-facing surfaces 33d and 38d at both ends indicated by an angle at the rotational center 21, is set to be 75° with respect to a point aligned with the rotational center 21 of the rotor 2.

[0025]

In the yoke 32, a surface 32a, on which the magnet pole

teeth 33 to 38 are connected, i.e., a surface 32a facing the rotor 2, is established to have an arch shape in plan view. The surface 32a, as shown in Fig. 4, is established so as to have an arch shape with a radius of R2 about a point 39, which is set at a position separated from the stator 3 further than the point aligned with the rotational center 21 of the rotor 2. Simultaneously, base-end centers 33f and 38f of the magnet pole teeth 33 and 38 connected to the surface 32a are established so as to have the same distance from the rotational center 21, respectively. Also, base-end centers 34f and 37f of the magnet pole teeth 34 and 37 are established so as to have the same distance from the rotational center 21, respectively; base-end centers 35f and 36f of the magnet pole teeth 35 and 36 are established so as to have the same distance from the rotational center 21, respectively. That is, the shape of the stator core 31 is established to be linearly symmetrical with respect to the rotational center 21 and a straight line L1 passing through the point 39.

[0026]

In the magnet pole teeth 33 to 38, as shown in Fig. 4, the base-end centers 33f to 38f are arranged at equal intervals of a pitch P2. That is, the pitch P2 of the base-end centers 33f to 38f is a spacing between central positions of adjacent magnet pole teeth 33 to 38 along the surface 32a at the base end in the circumferential direction indicated by an angle at the point 39. The pitch P2 of the base-end centers 33f to 38f is set at a value smaller than the pitch

P1 of the rotor-facing surfaces 33d to 38d, at 7°, for example.

Wherein the pitch P2 of the base-end centers 33f to 38f is established so that at least one of intersecting angles held by extending directions of the adjacent magnet pole teeth 33 to 38 is reduced smaller than intersecting angles held by straight lines connecting the rotor-facing surfaces 33d to 38d of the adjacent magnet pole teeth 33 to 38 to the rotational center 21 of the rotor 2. That is, in each of the magnet pole teeth 33 to 38, at least one angle P2 of angles at the point 39, at which extended straight lines connecting the base-end centers 33f to 38f to the central positions 33g to 38g in the circumferential direction of the rotor-facing surfaces 33d to 38d intersect each other, is set smaller than the angle P1 held by straight lines connecting the central positions 33g to 38g in the circumferential direction of the rotor-facing surfaces 33d to 38d and the rotational center 21.

[0027]

Wherein, the point 39 is set to be located outside the rotor 2.

Furthermore, in each of the magnet pole teeth 33 to 38, the winding portions 33c to 38c having the same width size along the extending direction, as shown in Fig. 4, are arranged so as to align with the extending straight lines connecting the base-end centers 33f to 38f to the point 39, respectively. The drawing shows the relationship between the winding portion 38c in the magnetic pole tooth 38 and the straight line connecting the base-end center 38f to the point

39.

[0028]

By setting such pitches P1 and P2, lengths L33 to L35 and lengths L36 to L38 of the winding portions 33c to 38c in each of the magnet pole teeth 33 to 38 are established to be different from each other. That is, as shown in Figs. 3 and 4, the length L33 of the winding portion 33c is longer than the length L34 of the winding portion 34c; the length L34 of the winding portion 34c is longer than the length L35 of the winding portion 35c; the length L33 of the winding portion 33c is equal to the length L38 of the winding portion 38c; the length L34 of the winding portion 34c is equal to the length L37 of the winding portion 37c; and the length L35 of the winding portion 35c is equal to the length L36 of the winding portion 36c. In other expression:

$$L33 = L38 > L34 = L37 > L35 = L36.$$

The lengths of the winding portions are set as above.

[0029]

In the coils 33a to 38a, the number of winding turns N33 to N35 and N36 to N38 are established to be different from each other. These number of turns N36 to N38 can be established in proportion to lengths L33 to L38 of the winding portions 33c to 38c, respectively. For example, the number of turns N33 is larger than the number of turns N34; the number of turns N34 is larger than the number of turns N35; the number of turns N33 is equal to the number of turns N38; the number of turns N34 is equal to the number of turns N37; and the number of turns N35 is equal to the number of

turns N36. In other expression:

$$N33 = N38 \geq N34 = N37 \geq N35 = N36.$$

The number of turns is set as above.

[0030]

Furthermore, the coils 33a to 38a are wound corresponding to three-phase (U-phase, V-phase, and W-phase) and in accordance with the rotor 2 with 16 poles, so that the coil 33a is set to the U-phase; the coil 34a is set to the W-phase; the coil 35a is set to the V-phase; the coil 36a is set to the U-phase; the coil 37a is set to the W-phase; and the coil 38a is set to the V-phase.

Therefore, sum Nu of the U-phase number of turns is N33 + N36; sum Nv of the V-phase number of turns is N35 + N38; sum Nw of the W-phase number of turns is N34 + N37, which are equally set. That is set:

$$Nu = Nw = Nv.$$

Thereby, torques in the three-phase (U-phase, V-phase, and W-phase) can be equally established relative to the rotor 2.

[0031]

In the structure described above, the stator 3 may be located within the range of a central angle Q of 180° about a point aligned with the rotational center 21 of the rotor 2 on a surface on one side of the rotor 2, i.e., surface parallel with the rotational surface of the rotor 2, or furthermore may be located within the range of 90°.

In such a manner, by setting the stator 3 within a central angle of 180°, the stator core area in plan view can be preferably reduced by about half or less in comparison

with the case where the stator is located around th entire circumference. Also, it is more preferable to set the stator 3 within a central angle of 90°, so that the stator core area can be further reduced.

[0032]

Fig. 5 is a schematic plan view showing the relationship between the magnet 25 shown in Fig. 1 and the magnet pole teeth 33 to 38.

The stator 3 and the rotor 2, as shown in Fig. 5, are arranged so that the rotor-facing surfaces 33d to 38d oppose the rotor 2, whereas, the relationship between each of the magnet pole teeth 33 to 38 and the magnet 25 is as follows.

That is, as described above, in the circumferential direction of the rotor 2, the magnet poles 25n, 25s, ··· are arranged at intervals of a pitch of 22.5° about the rotational center 21. This pitch is indicated by P3 in Fig. 5. On the other hand, as described above, the pitch P1 of the rotor-facing surfaces 33d to 38d in the circumferential direction is set to be 15°, for example. That is, to one of the magnet poles 25n, 25s ··· , one magnet pole tooth 33 and half of the magnet pole tooth 34, i.e., 1.5 of the magnet pole teeth 33 to 38, correspond. In the drawing, the magnet pole teeth 37 and 38 are omitted.

[0033]

That is, each arrangement of magnet poles in the stator 3 and the rotor 2, as shown in Fig. 5, when the central position (end center) 33g in the circumferential direction of the rotor-facing surface 33d of the magnet pole tooth 33 is

located at a position opposing the boundary position 25a between the magnet pole 25s0 and the magnet pole 25n1, the central position 34g in the circumferential direction of the rotor-facing surface 34d of the adjacent magnet pole tooth 34 is located at a position opposing the second position 25b from the magnet pole 25s0 wherein the pitch P3 of the magnet pole 25n1 is divided into three. Simultaneously, the central position 35g in the circumferential direction of the rotor-facing surface 35d of the next magnet pole tooth 35 is located at a position opposing the first position 25c from the magnet pole 25n1 wherein the pitch P3 of the magnet pole 25s1 is divided into three. Also, the central position 36g in the circumferential direction of the rotor-facing surface 36d of the magnet pole tooth 36 is located at a position opposing the boundary position 25d between the next magnet pole 25s1 and the further next magnet pole 25n2.

[0034]

The shapes of the stator 3 and the rotor 2 of a three-phase motor will be described below.

Fig. 7 is a schematic plan view showing the relationship between the magnet 25 and magnet pole teeth 133 to 136 of a conventional motor, wherein for brevity, only three magnet pole teeth are shown and others are omitted; the magnet is shown in the same structure as that of the embodiment shown in Fig. 5; and like reference characters designate like components and the description thereof is omitted.

[0035]

In the conventional three-phase inner rotor motor shown

in Fig. 7, with respect to an electrical angle established to be 360° for a pair of magnet poles 25n and 25s of the rotor, the U-phase, V-phase, and W-phase are arrange so that the arrangement of the magnet pole teeth 133, 134, and 135 has a phase difference of electrical angle 120°.

Specifically, in the same way of Fig. 5, with respect to the magnet 25, when the central position 133g in the circumferential direction of the rotor-facing surface of the magnet pole tooth 133 is located at a position opposing the boundary position 25a between the magnet pole 25s0 and the magnet pole 25n1, the central position 134g in the circumferential direction of the rotor-facing surface of the adjacent magnet pole tooth 134 is located at a position opposing the first position 25c from the magnet pole 25n1 wherein the pitch P3 of the magnet pole 25s1 is divided into three. Simultaneously, the central position 135g in the circumferential direction of the rotor-facing surface of the next magnet pole tooth 135 is located at a position opposing the second position 25d from the magnet pole 25s1 wherein the pitch P3 of the magnet pole 25n2 is divided into three.

[0036]

In such a manner, in the conventional three-phase inner rotor motor shown in Fig. 7, the three magnet pole teeth 133, 134, and 135 are arranged at intervals of a pitch P4 of 30°, for example, about the rotational center 21. That is, if the magnet pole teeth are arranged around the entire periphery of the rotor 2 at the pitch P4, a stator with 12 poles is constituted. Wherein, in the conventional three-phase inner

rotor motor shown in Fig. 7, the U-phase coil receiving a first driving current, the V-phase coil receiving a second driving current advanced than the first current in phase by 120°, and the W-phase coil receiving a third driving current advanced than the second current in phase by 120° are arranged in an order of the U-phase, V-phase, and W-phase.

[0037]

Whereas, in the inner rotor motor according to the embodiment, the magnet pole teeth 133, 134, and 135 are arranged so as to establish the U-phase, V-phase, and W-phase with a phase difference of electric angle 120°, wherein the coil 33a is set to the U-phase; the coil 34a is set to the W-phase; the coil 35a is set to the V-phase; the coil 36a is set to the U-phase; the coil 37a is set to the W-phase; and the coil 38a is set to the V-phase.

In such a manner, the U-phase coil receiving a first driving current, the V-phase coil receiving a second driving current advanced than the first current in phase by 120°, and the W-phase coil receiving a third driving current advanced than the second current in phase by 120° are arranged in an order of the U-phase, W-phase, and V-phase. According to the embodiment, the pitch P1 of the rotor-facing surfaces 33d to 38d in the magnetic pole teeth 33 to 38 is set to be 15°, for example. Therefore, if the magnet pole teeth are arranged around the entire periphery of the rotor 2 at the pitch P1, a stator with 24 poles is constituted.

[0038]

Therefore, according to the embodiment, in the central

angle about the rotational center 21, the number of the magnet pole teeth arranged per unit angle is set larger than the number of magnet poles of the rotor 2. That is, according to the embodiment, the angular density of the magnetic pole teeth 33 to 38 about the central angle of the rotational center 21 is set larger than the angular density of the magnetic poles 25n and 25s. In contrast, in the conventional three-phase inner rotor motor shown in Fig. 7, the angular density of the magnetic pole teeth about the central angle of the rotational center 21 is set smaller than the number of the magnetic poles. That is, in the conventional three-phase inner rotor motor shown in Fig. 7, the angular density of the magnetic pole teeth 133 to 138 about the central angle of the rotational center is set smaller than the angular density of the magnetic poles 25n and 25s.

[0039]

Therefore, in the conventional three-phase inner rotor motor shown in Fig. 7, in order to arrange six magnet pole teeth, for example, a range of 120° is necessary about the central angle of the rotational center 21, the area of the stator is required by that amount.

Furthermore, if the magnet pole teeth 133, 134, and 135 are arranged on the straight line connecting the rotational center 21 to the central positions 133g, 134g, 135g ··· in the circumferential direction of the rotor-facing surfaces, in comparison with the case where they are arranged on a straight line passing through the point 39, which is located

at a position separated from the stator 3 further than the rotational center 21 as the present embodiment, the length of the yoke in the circumferential direction must be increased. Therefore, the area of the yoke in plan view cannot be decreased, and the area of the stator core 31 cannot be sufficiently reduced.

[0040]

At a position opposing the stator 3 with the rotor 2 therebetween, the magnetic balancer 7 is arranged for magnetically balancing the rotor 2 to the stator 3.

A plurality of the magnetic balancers 7, as shown in Figs. 1 and 2, are arranged in the periphery of the rotor 2 at the rotating position so as to oppose the circumferential surface of the magnet 25 of the rotor 2, and are integrally raised from the bottom surface of the chassis 1 contacting the notch 12 located below the rotary rotor 2.

[0041]

The magnetic balancer 7 is constituted of magnetic balancer portions 71 to 76 corresponding to the rotor-facing surfaces 33d to 38d of the stator 3. These portions are arranged so that the rotor-facing surfaces 71a to 76a are arranged to be symmetric about the rotational center 21 of the rotor with the rotor-facing surfaces 33d to 38d of the magnet pole teeth 33 to 38.

That is, in the magnetic balancer portion 71, the rotor-facing surface 71a is arranged to be symmetrical with the rotor-facing surface 33d about the rotational center 21. In the magnetic balancer portion 72, the rotor-facing surface

72a is arranged to be symmetrical with the rotor-facing surface 34d about the rotational center 21. Similarly, the rotor-facing surface 73a, the rotor-facing surface 74a, and the rotor-facing surface 75a are arranged to be symmetrical with the rotor-facing surface 35d, the rotor-facing surface 36d, and the rotor-facing surface 37d, respectively, about the rotational center 21.

[0042]

This is because owing to the shape of the magnetic balancer 7, the magnetic influence to the rotor 2 from the stator 3 is balanced so that the magnetic balance to the rotor 2 is maintained to be symmetrical about the rotational center 21.

[0043]

Specifically, the rotor-facing surfaces 71a to 76a are established so as to have an arch shape with a radius of R1' having the same distance to the point 21 aligned with the rotational center of the rotor 2. the radius R1' is set larger than the radius R1 established for the rotor-facing surfaces 33d to 38d, wherein it is established in view of the height of the magnetic balancer 7. The pitch of the rotor-facing surfaces 71a to 76a is set to be 15° in the same way of the pitch P1 of the rotor-facing surfaces 33d to 38d, for example.

[0044]

The lengths of the rotor-facing surfaces 71a to 76a in the circumferential direction are set so as to correspond to the lengths of the rotor-facing surfaces 33d to 38d of the

magnetic pole teeth 33 to 38, respectively.

That is, in the magnetic balancer portion 71, the length of the rotor-facing surface 71a in the circumferential direction is set equal to the length the rotor-facing surface 33d in the circumferential direction. In the magnetic balancer portion 72, the length of the rotor-facing surface 72a in the circumferential direction is set equal to the length the rotor-facing surface 34d in the circumferential direction. Similarly, in the magnetic balancer portion 73, the length of the rotor-facing surface 73a in the circumferential direction is set equal to the length the rotor-facing surface 35d in the circumferential direction; in the magnetic balancer portion 74, the length of the rotor-facing surface 74a in the circumferential direction is set equal to the length the rotor-facing surface 36d in the circumferential direction; in the magnetic balancer portion 75, the length of the rotor-facing surface 75a in the circumferential direction is set equal to the length the rotor-facing surface 37d in the circumferential direction; and in the magnetic balancer portion 76, the length of the rotor-facing surface 76a in the circumferential direction is set equal to the length the rotor-facing surface 38d in the circumferential direction.

[0045]

The magnetic balancer 7 is arranged at a position lower than the rotor 2. In other words, the central position of the magnetic balancer 7 in the height direction is arranged at a position lower than the central position of the magnet

25 of the rotor 2. The magnetic balancer portions 71 to 76 are set at substantially the same height and at lower than the top surface 26 of the magnet 25 of the rotor 2 as well. In other words, upper ends 71b to 76b of the magnetic balancer 7, as shown in Fig. 2, are set closer to the bottom surface of the chassis 1 than the top surface 26 of the magnet 25 of the rotor 2.

[0046]

The height of the magnetic balancer 7, i.e., the difference between the upper ends 71b to 76b of the magnetic balancer portions 71 to 76 and the top surface 26 of the magnet 25 is set so as to establish the downward (to the chassis 1) thrust load for maintaining the rotation stability of the rotor 2 along with the setting of the height displacement between the end portions 33b to 38b and the magnet 25.

[0047]

Then, the establishment of the shape of the above-mentioned magnetic balancer 7 will be described.

To the rotor 2, as shown in Fig. 2(b), a force F3 from the stator 3 is exerted while a force F7 from the magnetic balancer 7 is exerted. The force F3 acts aslant toward the bottom surface of the chassis 1 than the rotation surface of the rotor 2. This is because that on the rotor 2, the force F3 acts in the direction of the end portions 33b to 38b positioned lower than the magnet 25 of the rotor 2. Also, the force F7 acts aslant toward the bottom surface of the chassis 1 than the rotation surface of the rotor 2. This is

because that on the rotor 2, the force F3 acts in the direction of the magnetic balancer 7 positioned lower than the magnet 25 of the rotor 2.

[0048]

Wherein, the force F3 and the force F7 produce rotating moments on the rotor 2 with respect to the bearing 22. In order to stabilize the rotor 2 without slanting, theses F3 and F7 are required to satisfy the following equation (1):

$$
\begin{aligned}
&F7t \cdot (RA - RB) < F3t \cdot (RA + RB) \\
&F3t \cdot (RA - RB) < F7t \cdot (RA + RB)
\end{aligned}
\qquad (1)
$$

Where as shown in Figs. 2(a) and (b),

$F3t = F3 \cos \theta_1$ (vertical direction component of F3)

$F7t = F7 \cos \theta_2$ (vertical direction component of F7)

RA: radius of the external peripheral surface of the magnet 25 with respect to the rotational center 21

RB: rotational radius of the bearing 22 with respect to the rotational center 21.

[0049]

Thereby, with the sum of the force F3t and F7t, the forces F3 and F7 can apply the thrust force to the rotor 2 in the direction of the rotational shaft of the rotor 2 for stabilizing the rotation of the rotor 2. That is, the rotor 2 is pushed to the bottom surface of the chassis 1 from the periphery.

At this time, in between the notches 11 and 14, between

the notches 14 and 12, between the notches 12 and 13, and between the notches 13 and 11, the magnetic flux from the magnet 25 enters the bottom surface of the chassis 1, respectively, so that the downward thrust force acts on the rotor 2.

Therefore, the force F3 and the force F7 are established so that this downward force to the rotor 2 can stabilize the rotation of the rotor 2 and cannot be inhibited by the frictional effect duet to increase in the thrust force of the rotational shaft of the rotor 2.

[0050]

Simultaneously, in the forces F3 and F7, in the direction perpendicular to the rotational shaft of the rotor 2, i.e., the direction parallel to the bottom surface of the chassis 1, a force F7p is set larger than a force F3p. Specifically, as shown in Fig. 2(b), the left facing force F3p is set smaller than the right facing force F7p. Thereby, by applying the right facing force F2 shown in Fig. 2(b), i.e., the force acting from the stator 3 toward the magnetic balancer 7, to the rotational shaft 21 of the rotor 2, the rotational shaft of the rotor 2 is stabilized.

[0051]

The following parameters are considered for setting the above-mentioned forces F3 and F7:

The areas of the rotor-facing surfaces 33d to 38d

The distances between the rotor-facing surfaces 33d to 38d and the external peripheral surface of the magnet 25

The height positions between the rotor-facing surfaces

33d to 38d and the magnet 25

The areas of the rotor-facing surfaces 71a to 76a

The distances between the rotor-facing surfaces 71a to 76a and the external peripheral surface of the magnet 25

The height positions between the rotor-facing surfaces 71a to 76a and the magnet 25

By combining these, the optimum state is established.

[0052]

The magnetic head 4 is composed of a first head 41 and a second head 42 arranged to vertically oppose each other for reading and writing magnetic signals from and to the disk, and these are attached to a head carriage 43. These first and second heads 41 and 42 are positionally controlled by the position controller 5.

[0053]

The position controller 5, as shown in Fig. 1, includes a stepping motor 51 for feeding the head carriage 43, and the stepping motor 51 is fixed to the rear center of the chassis 1 as a driving source for driving the head carriage 43 in the back and force directions. The output shaft of the stepping motor 51 is composed of a lead screw bar 52 extending in the back and forth directions and having a spiral V-groove, and is journaled at an end by a bearing. A guide bar 53 is provided thereon in parallel to the lead screw bar 52, and the guide bar 53 is fixed to the rear center of the chassis 1 so as to guide the head carriage 43, which will be described later, in the back and force directions.

[0054]

The head carriage 43 includes a needle pin 54 protruding in the obliquely rear and a leaf spring for urging the needle pin 54 in the V-groove of the lead screw bar 52. The head carriage 43 is inserted by the guide bar 53 movably in the back and forth directions and is arranged in the upper portion of the chassis 1. At an end of the head carriage 43, the magnetic head 41 is held for reading the recorded information on the disk while at the upper rear end, a head arm 55 having a magnetic head 42 corresponding to the magnetic head 41 is swingably attached with an elastic body therebetween. The head arm 55 is rotationally urged by a torsion spring 56 in a direction that the magnetic head 42 approaches the magnetic head 41 and is provided with a stopper protruding in the side and disposed on a side edge for restricting the arm rotation.

[0055]

The substrate 6 is provided with the positional controller 5, chips 61 and 61 for drive-controlling the inner rotor motor as the controller, and a capacitor 62.

[0056]

The rotor 2 is provided with the magnetic shield 8 disposed adjacent to the magnetic head 4 for shielding the magnetic flux from the magnet 25 against the magnetic heads 41 and 42.

Fig. 6 is a sectional view at the line VI-VI of Fig. 1 showing the magnetic shield of the inner rotor motor viewed in arrow direction.

The magnetic shield 8, as shown in Figs. 1 and 6, is

arranged in the periphery of the rotor 2 at the rotating position so as to oppose the circumferential surface of the magnet 25 of the rotor 2, and are integrally raised from the bottom surface of the chassis 1 contacting the notch 13 located below the rotary rotor 2.

[0057]

This magnetic shield is constructed like a straight line in plan view, and the length thereof is set so that the magnet 25 of the rotor 2 hides away when viewing the rotor 2 from the magnet 25. That is, it may have the length that can shield the magnetic flux from the magnet 25 so as not to affect the operations of the magnetic heads 41 and 42.

The linear magnetic shield 8 is located so that the central portion thereof mostly approaches the rotor 2, and the distance between a rotor-facing surface 8a and the magnet 25 is longer at both ends of the magnetic shield 8 while is shortest at the central portion.

[0058]

Thereby, even when the length of the magnetic shield 8 is different from a length corresponding to the two adjacent magnetic poles 25n and 25s of the magnet 25 shown in Fig. 5, the magnetic flux entering the magnetic shield 8 from the magnet 25 of the rotating rotor 2 can be prevented from increasing rapidly. Therefore, the magnetic flux can gradually change to its maximum value, cogging can be prevented from being produced, thereby enabling the detent torque to be reduced.

[0059]

Wherein, as the optimum length of the magnetic shield 8 for preventing the cogging, it seems to be set substantially the same as a length corresponding to the two adjacent magnetic poles 25n and 25s of the magnet 25 shown in Fig. 5; however, if the length is set substantially the same length of the two adjacent magnetic poles 25n and 25s of the magnet 25, the size of the notch 13 becomes larger corresponding to the length of the magnetic shield 8. Therefore, the strength of the chassis 1 may be reduced.

Then, when preventing the cogging and maintaining the strength of the chassis 1 by reducing the length of the magnetic shield 8 shorter than those of the two adjacent magnetic poles 25n and 25s of the magnet 25, it is necessary to establish the distance between the rotor-facing surface 8a of the magnetic shield 8 and the rotating surface of the rotor 2 to be increased and decreased gradually, thereby preventing the cogging without reducing the strength.

[0060]

The upper end 8b of the magnetic shield 8, as shown in Fig. 6, is substantially flush with the top surface 26 of the magnet 25 of the rotor 2. Wherein, the size of the rotor-facing surface 8a in the height direction is set to be substantially the same as that of the magnet 25. Thereby, the magnetic flux from the magnet 25 is prevented so as to prevent the magnetic flux from the magnet 25 from affecting the operation of the magnetic head 42. The shape of the magnetic shield 8 is formed so as to pull the magnet only in the horizontal direction, reducing the vertical load applied

to the rotor 2.

That is, by setting the shape, the vertical load applied to the rotor 2 can be established.

[0061]

At a position opposing the magnetic shield 8 with the rotor 2 therebetween, the magnetic balancer 9 is arranged for magnetically balancing the rotor 2 to the magnetic shield 8.

The magnetic balancers 9, as shown in Figs. 1 and 6, are arranged in the periphery of the rotor 2 at the rotating position so as to oppose the circumferential surface of the magnet 25 of the rotor 2, and are integrally raised from the bottom surface of the chassis 1 contacting the notch 14 of the chassis 1 located below the rotary rotor 2.

[0062]

The magnetic balancer 9 is constructed corresponding to the magnetic shield 8, and is arranged to be symmetric with the magnetic shield 8 about the rotational center 21 of the rotor.

That is, the length of the linear magnetic balancer 9 is set to be the same as that of the magnetic shield 8, while the position of the rotor 2 relative to the magnet 25 is also located so that the central portion thereof mostly approaches the rotor 2, and the distance between a rotor-facing surface 9a and the magnet 25 is longer at both ends of the magnetic balancer 9 and is shortest at the central portion.

[0063]

The top end 9a of the magnetic balancer 9, as shown in Fig. 6, is flush with the top surface 26 of the magnet 25 of

the rotor 2, and in the same way as the rotor-facing surface 8a of the magnetic shield 8, the size thereof in the height direction is set to be the same as that of the magnet 25 or larger.

Furthermore, the chassis 1 is provided with through-holes 82 and 92 formed at the bases of the magnetic shield 8 and the magnetic balancer 9 for reducing the stress affecting the bottom surface of the chassis 1 produced when press-bending the magnetic balancer 9 and the chassis 1.

[0064]

In such a manner, by arranging the magnetic balancer 9 to be symmetric with the magnetic shield 8 about the rotational center 21 of the rotor 2, the magnetic influence to the rotor 2 from the magnetic shield 8 is balanced so that the magnetic balance to the rotor 2 is maintained to be symmetrical about the rotational center 21.

[0065]

The magnetic balancer 7, the magnetic shield 8, and the magnetic balancer 9, as shown in Figs. 1, 2, and 6, are provided with convex cartridge supports 77, 81, and 91 protruding upper than the top surface 26 of the magnet 25 formed at the upper ends 73b, 8b, and 9b, respectively. These cartridge supports 77, 81, and 91 are provided for supporting a disk cartridge so as not to touch the rotating part of the rotor 2 even when the disk cartridge such as a floppy disk is thermally deformed. Therefore, the upper end of these cartridge supports 77, 81, and 91 is set in height not to hinder the disk of the rotor 2 from rotating and so

that the cartridge does not hinder the rotor 2 from rotating.

[0066]

In the inner rotor motor and the disk device according to the embodiment, the stator 3 is located within the range of a central angle Q of 180°, more preferably 90°, about a point aligned with the rotational center 21 of the rotor 2 on a surface on one side of the rotor 2, i.e., surface parallel with the rotational surface of the rotor 2, so that the stator core area can be reduced by about half or less in comparison with the case where the stator is located around the entire circumference, thereby reducing the manufacturing cost of the inner rotor motor by decreasing the cost for the stator core made of a silicon steel plate and for the coil winding.

Simultaneously, miniaturizing of the device is enabled in comparison with the case where the stator is located around the entire circumference by reducing the area required for attaching the motor while the reduction in weight can be made because the number of magnet pole teeth can be reduced.

Also, in the disk device according to the embodiment, miniaturizing of the device is enabled by reducing the area required for attaching the motor while the reduction in weight can be made because the number of magnet pole teeth can be reduced.

[0067]

In the inner rotor motor and the disk device according to the embodiment, the magnetic balancer 7 is arranged outside the circumstance of the rotor 2 for magnetically

balancing the rotor 2 to the stator 3, so that even when the stator 3 is arranged only one side of the rotor 2 so as to drive the rotor 2 from the one side, the force acting on the rotor 2 can be symmetrically well-balanced with respect to the rotational shaft of the rotor 2, enabling the rotary drive stability of the rotor 2 to be sufficiently maintained.

[0068]

The magnetic balancer 7 according to the embodiment is integrally raised from the bottom surface of the chassis 1 contacting the notch 12 located below the rotary rotor 2, so that during the fabricating the chassis 1 made of the silicon steel plate, for example, the magnetic balancer 7 and the chassis 1 can be simultaneously formed by bending and raising the portion of the notch 12 to the rotor attaching side below the rotary rotor 2 with press-punching. Thereby, the manufacturing process can be simplified and the manufacturing cost is can be reduced by cutting the material cost in comparison with the case where a separate part is attached as the magnetic balancer 7.

[0069]

As the magnetic balancer 7 is composed of a plurality of the magnetic balancer portions 71 to 76 segmentized in the circumferential direction of the rotor 2, as described above, during the fabrication by bending and raising the chassis 1 made of a galvanized steel plate, for example, the deformation on the bottom surface of the chassis 1 can be prevented when forming the rotor-facing surfaces 71a to 76a curved corresponding to the external circumferential surface

of the rotor 2, improving the fabrication easiness. Also, when setting the magnetic balance on the magnetic pole teeth 33 to 38 disposed separated in the circumferential direction of the rotor 2, the magnetic symmetry of the rotor-facing surfaces 71a to 76a with the magnetic pole teeth 33 to 38 can be easily achieved.

[0070]

In the magnetic balancer 7 according to the embodiment, the arrangement of magnetic balancer portions 71 to 76 and the arrangement of the rotor-facing surfaces 33d to 38d of the magnetic pole teeth 33 to 38 are symmetrically established about the rotational center 21 of the rotor 2 while the sum of lengths of the rotor-facing surfaces 71a to 76a occupying for the external periphery of the magnet 25 and the sum of lengths of the rotor-facing surfaces 33d to 38d of the magnetic pole teeth 33 to 38 occupying for the external periphery of the magnet 25 are equally established to each other, enabling the action applied by the magnetic balancer 7 and the stator 3 to the rotor 2 to be symmetrically established about the rotational center 21 of the rotor 2 more easily.

[0071]

In the magnetic balancer 7: in the magnetic balancer portion 71, the rotor-facing surface 71a is symmetrically arranged with the rotor-facing surface 33d about the rotational center 21 while the length of the rotor-facing surface 71a in the circumferential direction is set equal to the length the rotor-facing surface 33d in the

circumferential direction; and in the magnetic balancer portion 72, the rotor-facing surface 72a is symmetrically arranged with the rotor-facing surface 34d about the rotational center 21 while the length of the rotor-facing surface 72a in the circumferential direction is set equal to the length the rotor-facing surface 34d in the circumferential direction. Similarly, in the magnetic balancer portion 73, the rotor-facing surface 73a is symmetrically arranged with the rotor-facing surface 35d about the rotational center 21 while the length of the rotor-facing surface 73a in the circumferential direction is set equal to the length the rotor-facing surface 35d in the circumferential direction; in the magnetic balancer portion 74, the rotor-facing surface 74a is symmetrically arranged with the rotor-facing surface 36d about the rotational center 21 while the length of the rotor-facing surface 74a in the circumferential direction is set equal to the length the rotor-facing surface 36d in the circumferential direction; in the magnetic balancer portion 75, the rotor-facing surface 75a is symmetrically arranged with the rotor-facing surface 37d about the rotational center 21 while the length of the rotor-facing surface 75a in the circumferential direction is set equal to the length the rotor-facing surface 37d in the circumferential direction; and in the magnetic balancer portion 76, the rotor-facing surface 76a is symmetrically arranged with the rotor-facing surface 38d about the rotational center 21 while the length of the rotor-facing surface 76a in the circumferential direction is set equal to

the length the rotor-facing surface 38d in the circumferential direction, enabling the action applied by the magnetic balancer 7 and the magnetic pole teeth 33 to 38 to the rotor 2 to be symmetrically established about the rotational center 21 of the rotor 2 more easily in the design of the magnetic circuit.

[0072]

In addition, according to the embodiment, as described above, the magnetic balancer 7, the magnetic shield 8, and the magnetic balancer 9 are constructed separately; alternatively, as shown in Fig. 8, a magnetic balancer 80 also serving as a magnetic shield and a magnetic balancer 90 also serving as a magnetic balancer for the magnetic shield may be constructed.

[0073]

The magnetic balancer 80, as shown in Fig. 8, is arranged in the periphery of the rotor 2 at the rotating position so as to oppose the circumferential surface of the magnet 25 of the rotor 2, and is integrally raised from the bottom surface of the chassis 1 contacting the notch 15 of the chassis 1 located below the rotary rotor 2.

The magnetic balancer 80 includes a plurality of elements and is composed of a magnetic shield portion 85 arranged corresponding to the magnetic head 4 and magnetic balancer portions 86 and 76 arranged adjacent to the magnetic shield portion 85.

The length of the magnetic shield portion 85 in the circumferential direction is established equal to a length

corresponding to the two adjacent magnetic poles 25n and 25s, so that the cogging cannot be produced.

[0074]

At a position opposing the magnetic balancer 80 with the rotor 2 therebetween, the magnetic balancer 90 is arranged for magnetically balancing the rotor 2 to the magnetic balancer 80.

The magnetic balancer 90, as shown in Fig. 8, is arranged in the periphery of the rotor 2 at the rotating position so as to oppose the circumferential surface of the magnet 25 of the rotor 2, and are integrally raised from the bottom surface of the chassis 1 contacting the notch 16 of the chassis 1 located below the rotary rotor 2.

[0075]

The magnetic balancer 90 is constructed corresponding to the magnetic balancer 80, and is arranged symmetrically with the magnetic shield 85 about the rotational center 21 of the rotor.

That is, the length of the magnetic balancer portion 95 is set to be the same as that of the magnetic shield 85, while the position of the rotor 2 relative to the magnet 25 is also set equally to the magnetic shield 85.

[0076]

Also, these magnetic shields 80 and 90 are arranged so as to balance the stator 3 with the rotor 2 by combining the magnetic effect thereof.

[0077]

Wherein, since the space between the notch 15 and the

notch 16 is larger than that between the notch 12 and the notch 13 or between the notch 12 and the notch 14, by the magnetic flux entering the bottom surface of the chassis 1 from the magnet 25, the downward thrust force acting on the rotor 2 is increased, so that the upper ends of the magnetic shields 80 and 90 are set at positions higher than the upper end of the magnetic balancer 7.

[0078]

Similarly, as the structure where the downward force is exerted such as the force F7 shown in Fig. 2(b) acting between the rotor 2 and the magnetic balancer 7, the upper end 7b' of a magnetic balancer 7', as shown in Fig. 9, a structure is enabled which is flush with the top surface 26 of the magnet 25 of the rotor 2 while a rotor-facing surface 7a' is aslant in a direction separating from the external periphery of the rotor 2 from the base end to the end extremity. That is, since the distance between the rotor-facing surface 7a' and the external periphery of magnet 25 is decreased from the upper portion to the lower portion, an obliquely downward force is exerted between the rotor 2 and the magnetic balancer 7'.

[0079]

[Advantages]

In the inner rotor motor and the disk device according to the present invention, there are advantages that the stator is located within a range of 180° about a central angle of the rotor, so that the stator core area can be reduced by about half or less in comparison with the case where the

stator is located around the entire circumference, thereby reducing the manufacturing cost of the inner rotor motor by decreasing the cost for the stator core made of a silicon steel plate and for the coil winding, and miniaturizing is enabled in comparison with the case where the stator is located around the entire circumference by reducing the area required for attaching the motor while the reduction in weight can be made because the number of magnet pole teeth can be reduced. In this state, the pitch of between rotor-facing surfaces of the magnetic pole teeth in the circumferential direction of the rotor is established smaller than a pitch of between the magnet poles in the circumferential direction of the rotor, so that in comparison with the case where the pitch of the magnetic pole teeth is the same as or larger than the pitch of the rotor magnetic poles, the area of the magnetic pole teeth is reduced while the area of portions, to which the magnetic pole teeth are connected, i.e., the area of the yoke is reduced, thereby miniaturizing the stator in particular and enabling the manufacturing cost to be reduced by miniaturizing the coil winding.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a plan view showing an embodiment of an inner rotor motor and a disk device according to the present invention.

[Fig. 2]

Fig. 2(a) is a sectional view of the inner rotor motor

at the line II-II of Fig. 1 viewed in arrow direction; and Fig. 2(b) is an enlarged sectional view showing a vicinity of a magnet 25 shown in Fig. 2(a).

[Fig. 3]

Fig. 3 is a plan view showing a stator 3 shown in Fig. 1.

[Fig. 4]

Fig. 4 is a plan view showing a stator core 31 shown in Fig. 1.

[Fig. 5]

Fig. 5 is a schematic plan view showing the relationship between the magnet 25 and magnetic pole teeth 133 to 136 shown in Fig. 1.

[Fig. 6]

Fig. 6 is a sectional view at the line VI-VI of Fig. 1 viewed in arrow direction showing a magnetic shield of an inner rotor motor.

[Fig. 7]

Fig. 7 is a schematic plan view showing the relationship between the magnet 25 and magnetic pole teeth 133 to 136 of a conventional motor.

[Fig. 8]

Fig. 8 is a plan view showing a magnetic shield and a magnetic balancer according to another embodiment of the present invention.

[Fig. 9]

Fig. 9 is a sectional view showing a magnetic balancer according to another embodiment of the present invention.

[Fig. 10]

Fig. 10 is a schematic perspective view of a conventional disk device.

[Fig. 11]

Fig. 11 includes a plan view of a conventional inner rotor motor (a) and a sectional view thereof (b).

[Reference Numerals]

1: chassis

2: rotor

3: stator

4: magnetic head

5: positional controller

6: substrate

7: magnetic balancer

8: magnetic shield

8a: rotor-facing surface

8b: upper end

9: magnetic balancer

9a: rotor-facing surface

9b: upper end

11, 12, 13, 14, 15, 16: notch

25: magnet

25n, 25s: magnetic pole

26: top surface

31: stator core

32: yoke

33 to 38: magnetic pole teeth

33a to 38a: coils

33b to 38b: end portions

33c to 38c: winding portions

33d to 38d: rotor-facing surfaces

33f to 38f: base end centers

33g to 38g: central positions in the circumferential direction

71 to 76: magnetic balancer portions

71a to 76a: rotor-facing surfaces

71b to 71b: upper ends

77, 81, 91: cartridge support